

*BAGARYATSKIY, B.A.*

AUTHOR: Bagaryatskiy, B.A.

49-4-18/23

TITLE: Certain data on the distribution of energy in the infrared spectrum of the Aurorae **Borealis** (Nekotorye dannyye o raspredelenii energii v infrakrasnom spektre polyarnykh siyaniy).

PERIODICAL: Izvestiya Akademii Nauk SSSR, Seriya Geofizicheskaya, 1957, No.4, pp.540-542 (USSR)

ABSTRACT: The results are described of measurements of the relative intensities of infrared emissions in the 8000 to 10 000 Å range in two spectra of the Aurora Borealis which were obtained in March, 1956 by means of a diffraction spectrograph for an exposure time of four hours. The calculation of the intensities was carried out for the band of the first negative nitrogen system,  $\lambda = 3914 \text{ Å}$  and  $\lambda = 4278 \text{ Å}$  which were photographed simultaneously with second order infrared emissions. The aim of the measurements was to obtain approximate information on the intensity ratios. Therefore, as a photographic standard the spectrum of the Moon was used since during the period of the measurements the Moon was full. The results are entered in a table, p.542 and in the graphs, Fig.1. The results permit a rough evaluation of the integral intensity of the infrared

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AUTHOR: Bagaryatskiy, B. A.

49-11-11/12

TITLE: Work of Soviet Scientists Relating to the Illumination of the Night Sky and the Aurora Borealis. (Raboty Sovetskikh uchenykh po svetimosti nochnogo neba i Polyarnykh Siyaniy).

PERIODICAL: Izvestiya Akademii Nauk SSSR, Seriya Geofizicheskaya, 1957, No.11, pp.1410-1417 (USSR)

ABSTRACT: This is a very brief review of pre-war as well as post-war work in this field and the author limits himself predominantly to outlining the subject matter of the individual work concerned and giving the respective references. At the end of the review the author also mentions work relating to instrumentation in this field. A. I. Lebedinskiy, . . . designed in 1948 the first photo-camera with a spherical mirror which was described in a paper in 1955 (Ref.116); at present improved versions of this camera (C-180°) are fitted in the stations of the Chief Directorate of the Hydrometeorological Services (Glavnogo Upravleniya Gidrometsluzhby) of the Chief Directorate for the Northern Sea Passage (Glavnogo Upravleniya Severnogo Morskogo puti) and other establishments which, from July 1, 1957 onwards, carried out work in accordance with the I.G.Y. programme.

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Work of Soviet Scientists Relating to the Illumination of the Night Sky and the Aurora Borealis. 49-11-11/12

The State Optical Institute (Gosudarstvennyy Opticheskiy Institut) is perfecting apparatus for spectroscopic investigations; they developed not only terrestrial spectrographs (Ref.117) but also diffraction spectrographs which are unique as regards dispersion and resolution ability. These spectrographs (Series CП-48, CП-49, CП-50) are beginning to be used for regular service in work scheduled for the International Geophysical Year. The author emphasizes the enormous organizational effort which was necessary for preparing the investigations scheduled for the I.G.Y.; observations on the emission of the upper atmosphere are carried out at individual stations and in a whole network of stations. The network encompasses in longitude the most interesting points relating to the Aurora Borealis, namely, from Murmansk up to the Mysa Shmidta and in the meridional direction from Murmansk down to astronomical observatories in the south.

Card 2/2

There are 118 references, 111 of which are Slavic.

ASSOCIATION: Ac.Sc. U.S.S.R. Institute of Physics of the Atmosphere. (Akademiya Nauk SSSR, Institut Fiziki Atmosfery).

AVAILABLE: Library of Congress.

BAGARYATSKIY, B.A.

Function of the aurorial proton distribution on zenith angles.  
Astron. zhur. 35 no.3:495 My-Je '58. (MIRA 11:6)  
(Auroras) (Cosmic physics)

AUTHOR: Bagaryatskiy, B. A.

SOV/53-65-4-4/13

TITLE: Hydrogen Emission in the Spectra of the Polar Lights (Vodorodnaya emissiya v spektrakh polyarnykh siyaniy)

PERIODICAL: Uspekhi fizicheskikh nauk, 1958, Vol 65, Nr 4, pp. 631 - 664 (USSR)

ABSTRACT: The discovery of the double displacement of the hydrogen lines in the spectra of the polar lights is a first class event for geophysics, heliophysics, and astronomy. It proves the presence of a corpuscular stream moving towards the earth which predominantly consists of electrons and protons. The investigation of the spectra of the polar lights gives information about the interaction of this corpuscular stream with the outer terrestrial atmosphere. In the present paper the author first discusses some spectrograms (Figs 1,2) and gives a comprehensive list of the known data on hydrogen lines from various observations of polar lights. Mainly non-Soviet sources are considered (Meinel(Meynel), Vegard, Petrie et al.) Among the Russian research workers above all the work and the experimental data by Gal'perin (Murmansk, USSR, 1956/58) and Isayev (Murmansk, 1956) are discussed in great detail.

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Some results are as follows (velocities in km/sec):

Gal'perin 1956	H <sub>α</sub>	7Å	300	40Å	1850	5Å	250	
		8Å	350	43Å	1950	8Å	350	
		9Å	400	45Å	2050	7Å	300	
Gal'perin 1957	H <sub>α</sub>	9Å	400	38Å	1700	7Å	300	
		6,5Å	400	33Å	2000	5Å	300	
		H <sub>β</sub>	3,5 Å	250	23Å	1600	7Å	500

The values of the first column concern the displacement of the maximum and the proton velocity in the maximum; the values of the second column concern the greatest widening in the violet part and the highest velocity of approximation; the values of the third column give the greatest widening in the red range and the highest withdrawal velocity. Furthermore papers and results by I.S.Shklovskiy (in great detail), Pikel'ner, Mitra, Dzhordzho, Bagaryatskiy and Mustel' are discussed. (all of them from the USSR). Finally the author expresses his opinion that in the plasma moving towards the earth not only protons and electrons but also helium ions are to be found; the most important problem in new

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Hydrogen Emission in the Spectra of the Polar Lights

SOV/53-65-4-4/13

research work is to find He-lines in the spectrum of the polar lights. To this in a footnote is added that a helium resonance line was found ( $\lambda = 10830 \text{ \AA}$ ) in the spectrum of the latitudinal aurora on February 10 - 11, 1958. The discovery was made by Mironov, Prokudina and Shefov at the Stantsiya Instituta fiziki atmosfery (Station of the Institute of Atmospheric Physics) (Ref 39). The station is situated at Zvenigorod. There are 22 figures, 5 tables, and 39 references, 11 of which are Soviet.

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SOV/49-59-6-7/21

AUTHOR: Bagaryatskiy, B. A.

TITLE: On the Doppler Contours and Curves of the Distribution of Luminosity of Hydrogen in Aurora Borealis

PERIODICAL: Izvestiya Akademii nauk SSSR, Seriya geofizicheskaya, 1959, Nr 6, pp 858-864 (USSR)

ABSTRACT: A homogeneous atmosphere is considered, the top of which receives a stream of protons, having a velocity  $u_0$ . The function  $N(\theta, \varphi)$  describes the stream at a point in space ( $\theta$  - angle of zenith,  $\varphi$  - azimuth), i.e. it represents the number of protons falling on  $1 \text{ cm}^2$  during 1 sec. The path of a proton in the air,  $s_0$ , is described by the normal conditions if the initial velocity is  $u_0$ . Then the lower limit of proton penetration into the atmosphere at  $\theta = 0$  is  $\zeta_0 = s_0$ . If  $r = s_0 - s$  is the distance to the end of the proton's path and  $u(r)$  - its velocity at a given point, then Eqs (1) and (2) are obtained. If the

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On the Doppler Contours and Curves of the Distribution of Luminosity of Hydrogen in Aurora Borealis

function  $Q^*(r) = Q(\xi, \theta)$  is introduced, which represents the number of protons  $H_\alpha$  (or  $H_\beta, H_\gamma$  etc) then  $H_\alpha$  emitted by one proton can be calculated from Eq (a) for the vertical thickness and the stream of protons on the horizontal level can be determined from Eq (b). The number of protons in a given layer is calculated from Eq (3) and the distribution of luminosity at height  $h$  from Eq (4). If the argument  $r$  is considered instead of  $u$ , the formulae (5) to (7) can be derived and Eq (3) written as Eq (8), or the luminosity of emission defined from Eq (9). The protons in the trajectory can be considered as the source of emission. Then for  $\varphi_1 \leq \varphi \leq \varphi_2$  it is necessary to have the whole azimuth from 0 to  $2\pi$ . Thus the formula (10) can be obtained, from which the zenith and horizontal Doppler contours of the hydrogen lines can be obtained. The former are calculated from Eqs (12) to (16) and the latter from

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On the Doppler Contours and Curves of the Distribution of Luminosity of Hydrogen in Aurora Borealis

Eqs (17) to (22) where  $D_z(v)$  - the function obtained from differentiating  $g_2$  in respect to  $v$  (Eq 16). There are 20 references, of which 7 are Soviet, 12 English and 1 French.

ASSOCIATION: Akademiya nauk SSSR, Institut fiziki atmosfery (Academy of Sciences of the USSR, Institute of Physics of the Atmosphere)

SUBMITTED: September 18, 1958.

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9.9100

66577

SOV/49-59-9-7/25

AUTHOR: Bagaryatskiy, B. A

TITLE: On the Effective Recombination Coefficient in the Ionosphere

PERIODICAL: Izvestiya Akademii nauk, SSSR, Seriya geofizicheskaya, 1959, Nr 9, pp 1359-1363 (USSR)

ABSTRACT: Bates (Ref 1) and V. I. Krasovskiy (Ref 2) have suggested that secondary chemical exchange reactions between ions and neutral components are an important mechanism, whereby the ion balance in the ionosphere is established. In particular, V. I. Krasovskiy has suggested that in the F-region the reaction  $O^+ + N_2 \rightarrow NO^+ + N$  plays an important role. This is particularly interesting in connection with the large concentration of  $NO^+$  ions which has recently been discovered in the ionosphere (Refs 3 and 4). However, the lack of reliable data on the elementary reaction rates means that it is difficult to derive any conclusions from the above ideas. The author, therefore, sets out to analyse the system of reactions put forward in Ref 2, namely:

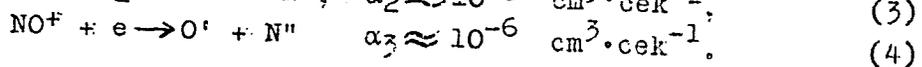
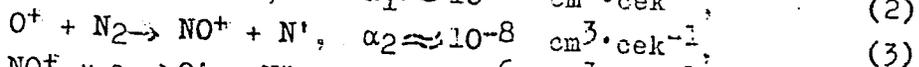
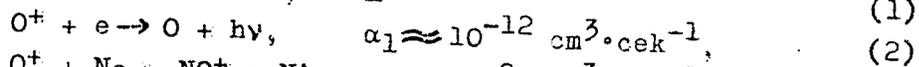
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## On the Effective Recombination Coefficient in the Ionosphere



The coefficient  $\alpha_1$  has been calculated theoretically by Bates (Ref 5) and its order of magnitude is not subject to doubt. The coefficient  $\alpha_2$  could, up to now, be estimated only very approximately. The value of  $\alpha_3$  is consistent with that given by Faure et al. (Ref 7). In the first approximation, the set of reactions given by Eqs (1) to (4) is considered as a closed system which sets up the ion balance. In this case, the equilibrium concentration of the ionic components may be written in the form given by Eqs (5) to (8), in which the concentration of the corresponding component is given in the square brackets and  $J$  is the rate of ionization at a given level in the atmosphere. For a given ionized component  $X$  the quantity  $J$  can, in principle, be determined from the

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On the Effective Recombination Coefficient in the Ionosphere

relation given by Eq (9), where  $\sigma$  is the effective photoionization cross-section for photons with energy  $h\nu$  and  $S$  is the flux of these photons at the given level in the atmosphere. In practice, all the three quantities in Eq (9) are not known sufficiently accurately and  $J$  is usually determined from ionospheric data. The coefficient  $J$  describes the loss of electrons associated with processes (2)-(4). It should not be identified with the recombination coefficient. The quantity  $J$  is related to the effective recombination coefficient  $\alpha_{\text{eff}}$  by Eq (10). The coefficient  $K$  is not proportional  $[e]$  and, consequently, the effective recombination  $\alpha_{\text{eff}}$  depends on  $[e]$ . If in Eqs (5)-(8)  $J$ ,  $\alpha_1$ ,  $\alpha_2$  and  $\alpha_3$  are known, the remaining quantities may be found, namely, the coefficient  $K$  and the equilibrium concentrations of  $O^+$ ,  $NO^+$  and  $e$ . The electron concentration is given by Eq (11). Solution of Eq (11) gives the general equation for the electron concentration given by Eq (12). It is shown that the  $[N_2]$  concentration is a parameter which determines the

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On the Effective Recombination Coefficient in the Ionosphere

possible change in the character of the recombination with altitude. It is suggested that there is some doubt as to whether the set of reactions given by Eqs (1)-(4) is complete. It is further suggested that apparently it is necessary to estimate the effect of at least the following processes: 1) photoionization of  $N_2$  with subsequent very fast dissociative recombination of  $N_2^+$ ; 2) charge exchange of  $O^+$  with  $N_2$ ,  $O_2$  and  $N$  respectively; 3) exchange reaction between  $N_2^+$  and  $O$  (analogous to reaction (3)); 4) formation of negative ions. Although reactions between neutral components do not affect directly the ion balance, they must also be taken into account in the case when they lead to an appreciable change in the concentration of some of the components. Apparently, convective processes (Ref 8) also play an important role in setting up the ion balance in the  $F_2$ -layer. There are 8 references, 2 of which are Soviet and 6 English.

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On the Effective Recombination Coefficient in the Ionosphere

ASSOCIATION: Akademiya nauk SSSR. Institut fiziki atmosfery  
(AS USSR, Institute of Physics of the  
Atmosphere)

SUBMITTED: December 20, 1958

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3(1)

AUTHORS: Bagaryatskiy, B.A., and Gal'perin, Yu.I. SOV/33-36-1-28/31

TITLE: On Hydrogen Line Profiles in the Spectra of Aurorae

PERIODICAL: Astronomicheskiy zhurnal, 1959, Vol 36, Nr 1, pp 192-193 (USSR)

ABSTRACT: In the present short note the authors compare their theoretical calculations with the averaged hydrogen emission profile observed in aurorae.

There are 7 references, 3 of which are Soviet, and 4 American.

ASSOCIATION: Institut fiziki atmosfery Akademii nauk SSSR (Institute of Atmospheric Physics of the AS USSR)

SUBMITTED: September 12, 1958

Card 1/1

BAGARYATSKIY, B.A., kand.fiziko-matem.nauk, otv.red.; FEL'DSHTEYN, Ya.I.,  
red.; MAKUNI, Ye.V., tekhn.red.

[Auroral investigations; collection of articles] Issledovaniia  
poliarnykh sifanii; sbornik statei. IV razdel programmy MGG  
(poliarnye sifanii i svechenie nochnogo neba). Moskva. No.4.  
1960. 77 p. (MIRA 14:1)

1. Akademiya nauk SSSR. Mezhduevdomstvennyy komitet po provedeniyu  
Mezhdunarodnogo geofizicheskogo goda.  
(Auroras) (Night sky)

20983

3,1810 (2605, 2705, 1041, 1184)  
9,9300

S/058/61/000/004/038/042  
A001/A101

AUTHOR: Bagaryatskiy, B.A.

TITLE: Some results of radar studies of auroras

PERIODICAL: Referativnyy zhurnal. Fizika, no 4, 1961, 419, abstract 4Zh622  
("Spektr. elektrofotometr. i radiolokats. issled. polyarn. siyaniy  
i svecheniya nohnogo neba", no 2-3, Moscow, AN SSSR, 1960, 7-14,  
Engl. summary)

TEXT: This is a survey of the present state of aurora radar studies. The principal problems of radio echo from aurora and physical nature of aurora are briefly discussed. It is mentioned that average distance of radio echoes amounts to 600 - 900 km; this is explained by the scattering effect of the magnetic field on auroral ionization in the aurora zones. Directions of incidence of radio echoes correlate better with magnetic field characteristics at the Earth's surface than with the geomagnetic field of the dipole located in the Earth's center. The course of excessive auroral ionization is the same in both Earth's hemispheres. Diurnal course of radio echoes is such that very few daily echoes are observed in

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Some results of radar studies of auroras

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A001/A101

comparison with the nightly ones. There is an unquestionable general correlation between visual auroras and radio echoes, but no particular identification was observed. Radio echoes originate from the great number of ionized non-homogeneities whose dimensions are comparable with the wavelength. It is pointed out that not all observed phenomena can be at present explained, and that there is as yet no complete theory of radio echoes from aurora. There are 40 references.

V. Naslednik

[Abstracter's note: Complete translation.]

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BAGARYATSKIY, B.A., kand. fiz.-matem.nauk, otv. red.; FEL'DSHTEYN, Ya.I.,  
red.; LAUT, V.G., tekhn. red.

[Auroras and airglow] Poliarnye silaniia i svechenie nochnogo neba;  
sbornik statei. IV razdel programmy MGG. Moskva, Izd-vo Akad.nak  
SSSR. No.7. 1961. 88 p. (MIRA 14:12)

1. Akademiya nauk SSSR. Mezhdovedomstvennyy komitet po provedeniyu  
Mezhdunarodnogo geofizicheskogo goda.  
(Auroras)

SLYSHA, V.I.[translator]; BAGARYATSKIY, B.A., red.; RUSKOL, Ye.L.,  
red.; PANTAYEVA, V.A., red.; DZHATUTEVAM F,Kh., tekhn. red.

[Experimental investigation of space near the earth] Eksperi-  
mental'noe issledovanie okolozemnogo kosmicheskogo prostran-  
stva. Moskva, Izd-vo inostr. lit-ry, 1961. 277 p.  
Translated from the English. (MIRA 15:4)  
(Solar system)

BAGARYATSKIY, B.A.

Discussion of the results of photoelectric measurements of the continuum of the airglow. Izv. AN SSSR. Ser. geofiz. no.12:1901-1902  
D '61. (MIRA 14:12)

(Night sky)

99840

S/053/61/073/002/001/003  
B117/B212

AUTHOR: Bagaryatskiy, B. A.

TITLE: Radar-reflections by polar aurora

PERIODICAL: Uspekhi fizicheskikh nauk, v. 73, no. 2, 1961, 197-241

TEXT: This is a survey of technical literature which has been published about radar studies of polar aurora. For the first time reflections of radio waves in the meterband have been observed from the ionosphere, which show the same characteristics as polar aurora zones, shortly before WWII. Much attention has been paid to radar investigations of polar aurora since 1947. The program of the International Geophysical Year also provided for studies of radar reflections of polar aurora. These phenomena have been observed in numerous countries and also in the USSR; here, studies of Ya. G. Birfel'd are especially stressed. The present survey mainly deals with material published before the middle of 1960. A large number of results is not included, because they have been evaluated and published. Chapter I deals with basic concepts of radio reflections of polar aurora. The author points out that "reflections by polar aurora" is not an exact physical term, it is

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Radar-reflections by ...

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used for convenience, and tradition only and one has to see in it reflections of regions with higher ionization, which are related to the polar aurora zones. Now follows an enumeration of new findings, based on available material, about the structure of the ionosphere and the possible radio reflection mechanisms. The following problems are discussed in chapter I: a) Range of reflections; b) type of reflections; c) characteristics with respect to polar aurora; d) duration of reflections; e) spatial distribution of reflection zones; f) response of reflections; g) comparison of reflection zones with visual properties of the structure of polar aurora; h) altitude of reflections. Chapter II of this survey deals with the change of radio reflections in the day time and at night and their correlation with geomagnetic activities. On the basis of the material available, it can be established that there is a definite dependence between magnetic disturbances and the occurrence of anomalies in the polar ionosphere, which show up as auroral radio reflections. It can be assumed that the ionosphere, due to corpuscular currents does obtain a number of properties in the polar aurora zone and also the region near the pole, which are missing if undisturbed and which have not been observed on other latitudes. Chapter III of this survey has been devoted to the relation of radio reflections and various

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Radar-reflections by ...

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peculiarities of the sporadic ionization near polar aurora zones. A considerable difference between sporadic ionization in medium latitudes and auroral sporadic ionization has been observed, this is especially characteristic for investigations of the far-range propagation of ultra short waves in the ionosphere. Chapter IV brings the geometry of reflections and chapter V the electron concentration. Concluding the author notes that the experimental data, which are mentioned in this paper, have been obtained during observations of radio reflections of polar aurora in the ultra short wave range. Most of the observation materials have been obtained by applying relatively simple radar techniques and methods. It was possible to establish various basic characteristics of the phenomena observed and also their position and the role which they played among other geophysical processes in high altitudes. Due to incomplete technical devices, it is difficult to establish more accurate characteristics and physical parameters, and the development of special methods and more perfected technical instruments is necessary. The author is also pointing out the necessity of forming a clear theory or a suited working hypothesis. In the beginning of radio investigations of polar aurora the geometric reflection scheme developed by Chapman was used

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Radar-reflections by ...

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as theoretical basis for the procedure. The steady increase of evaluated experimental data makes a theory more and more necessary, which could explain the occurrence of radio wave reflections from regions with an anomalously increased ionization in polar regions from a physical point of view. The number of observation stations which will be reduced after the IGY, could be compensated by application of new instruments and special methods. The following persons are mentioned: Ya. L. 'pert, F. F. Dobryakova, E. F. Chudesenko, B. S. Shapiro, K. I. Gringauz, V. N. Dovger, A. P. Nikol'skiy, V. I. Pogorelov, V. I. Yarin, B. Ye. Bryunelli, S. I. Sandulenko, Ya. I. Fel'dshteyn, R. A. Zevakina, Z. Ts. Rappoport, V. M. Driatskiy, A. S. Besprozvannaya, F. Ya. Zaborshchikova, N. I. Fedyakina, A. A. Aynberg, A. I. Grachev. There are 25 figures, 2 tables, and 86 references: 26 Soviet-bloc.

Card 4/4

KRASOVSKIY, V.I., doktor fiz.-matem. nauk, otv. red.; BAGARYATSKIY,  
B.A., kand. fiz.-matem. nauk, otv. red.; ZHITNIKOVA, S.A.,  
red.; DOROKHINA, I.N., tekhn. red.; MATYUKHINA, L.I.,  
tekhn. red.

[Collection of articles of the Intergovernmental Committee  
for the Execution of the International Geophysical Year]  
Sbornik statei Mezhduevostvennogo komiteta po provedeniiu  
Mezhdunarodnogo geofizicheskogo goda. Moskva, Izd-vo AN  
SSSR. No.10. 1963. 153 p. (MIRA 17:2)

1. Akademiya nauk SSSR. Mezhduevostvennyy komitet po pro-  
vedeniyu Mezhdunarodnogo geofizicheskogo goda. IV razdel prog-  
rammy MGG: Polyarnyye siyaniya i svecheniye nochnogo neba.

FEL'DSHEYN, Yakov Isaakovich; BAGARYATSKIY, B.A., kand. fiz.-  
mat. nauk, otv. red.; SHCHUKINA, Ye.P., red. izd-va;  
POLYAKOVA, T.V., tekhn. red.

[Collection of articles of the Intergovernmental Committee  
for the Execution of the International Geophysical Year]  
Sbornik statei Mezhduverdomstvennogo komiteta po provedeniiu  
Mezhdunarodnogo geofizicheskogo goda. Moskva, Izd-vo AN SSSR.  
No.5. [Space-time distribution of magnetic activity at high  
latitudes of the northern hemisphere] Prostranstvenno-  
vremennoe raspredelenie magnitnoi aktivnosti v vysokikh shi-  
rotakh severnogo polushariia. 1963. 63 p. (MIRA 17:2)

1. Akademiya nauk SSSR. Mezhduverdomstvennyy komitet po pro-  
vedeniyu Mezhdunarodnogo geofizicheskogo goda. III razdel prog-  
rammy MGG. Geomagnetizm i zemnye toki.

ACC NR: AT6026925

SOURCE CODE: UR/0000/66/000/000/0079/0088

AUTHOR: Bagaryatskiy, B. A.; Fel dshteyn, Ya. I.

ORG: none

TITLE: Auroral radar echo and structure of the polar current vortex

SOURCE: AN SSSR, Kol'skiy filial, Polyarnyy geofizicheskiy institut. *Vysokoshirotnyye issledovaniya v oblasti geomagnetizma i aeronomii (High-latitude studies in geomagnetism and aeronomy)*. Moscow, Izd-vo Nauka, 1966, 79-88

TOPIC TAGS: radar echo, atmospheric ionization, aurora, signal scattering

ABSTRACT: The physical theory of the so-called auroral radar echoes from the ionosphere of high latitudes in the 30-1000 Mc range includes two basic processes. The first concerns the mechanism of reflection or scattering by means of which it is possible to explain the occurrence of echo signals at these frequencies proceeding from the permissible values of the electron density in the regions of auroral ionization. The second question is associated with interpreting the characteristic space and time peculiarities inherent to this type of reflection. The present article is devoted to the second problem based on radar investigations of ionization in the polar aurora regions in the Northern Hemisphere. The 19 stations involved in the investigation

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ACC NR: AT6026925

were divided into two groups, in each of which the statistical characteristics of the observed radar echoes were substantially different. The statistical data revealed that reflections from regions close to the auroral zones occur with greatest probability during those hours of the day when, according to the theory of the polar current vortex, the current density is maximal. A later peak of reflections recorded at most middle-latitude stations between 2400 and 0400 local time is accompanied in all cases, without exception, by a decrease of the horizontal component of the magnetic field. The first peak occurring between 1700 and 2100 hr is characterized by the development of a different type of magnetic activity. It can be established that for stations of the Jodrell Bank type, near where the constant field is not disturbed by the presence of anomalies, this activity is associated with an increase of the horizontal component. It is concluded that reflection from the zone of polar auroras is an effect which owes its pattern of behavior to the development of the polar current vortex of a magnetic storm. The frequency of the appearance of radar echoes depends on the conditions of the occurrence, disappearance, and shift during the day of regions of high anomalous ionization. Therefore, the presence of a close relationship between magnetic disturbances and the appearance of radar echoes should be expected, and actually the time regularities of magnetic activity and auroral reflections occur identically in basic features. The periods of maximal values of the frequency of appearance of radar echoes vary in relation to the geomagnetic latitude of the station. A comparison of the spiral distributions of magnetic activity with the corresponding distributions of the auroral ultrashort-wave reflections revealed that they practically coincided in the entire range of in-

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ACC NR: AT6026925

Investigated latitudes. This indicated that the penetration of corpuscular fluxes into the upper layers of the atmosphere has a direct and simultaneous effect both on the occurrence of geomagnetic activity and on the appearance of radar ultrashort-wave reflections. Orig. art. has: 4 figures.

SUB CODE: 04,17/ SUBM DATE: 21Apr66/ ORIG REF: 008/ OTH REF: 011

Card 2/2

BAGARYATSKIY, B.A.; FEL'DSHTEYN, Ya.I.; LEBEDINSKIY, A.I., doktor  
fiz.-matem. nauk, otv. red.; MILYUTINA, Ye.N., red.

[Collection of articles] Sbornik statei. Moskva, Nauka.  
No.12. 1965. 56 p. (MIRA 18:4)

1. Akademiya nauk SSSR. Mezhdovedomstvennyy geofizicheskiy  
komitet. IV razdel programmy MGG. Polyarnyye siyaniya.

PA 14/49T108

BAGARYATSKIY, YU. A.

USSR/Physics

Jun 48

Crystals - Structure

Crystals - Measurements

"Cameras for X-Ray Structure Analysis of Monocrystals," Yu. A. Bagaryatskiy, M. M. Unamskiy, Inst of Phys, Moscow Order of Lenin State U imeni M. V. Lomonosov, 10 pp

"Zavod Lab" Vol XIV, No 6

Describes (1) universal X-ray camera for taking rotation X-ray photographs; (2) camera for determining identity periods of a crystal. Photographs and diagrams.

14/49T108

*BAGARYATSKIY, YU. A.*  
BAGARYATSKIY, YU. A.

Rentgenograficheskoe issledovanie starenia aliuminievykh splavov. 1. Primenenie monokhromaticheskikh rentgenovykh luchei dlia izucheniia struktury ostarenykh splavov. (Zhurnal tekhnicheskoi fiziki, 1948, v.18, no.6, p.827-830. plate).

Includes bibliography.

Title tr.: X-ray investigation of the ageing of aluminum alloys. 1. Use of monochromatic X-ray for the investigation of the structure of aged alloys.

For abstract see Index Aeronauticus,,1951, v.7, no.7, no.11, p.165

QC1.Z48 1948

SO: Aeronautical Sciences and Aviation in the Soviet Union, Library of Congress, 1955.

C A B A H A H Y H I O K I T , Y. A.

3

**Determination of the orientation of coarse single crystals.**  
 Yu. A. Bagaryatski and E. V. Kolontsova (Moscow State Univ.). *Zavodskaya Lab.* 15, 1002-71(1949); cf. *C.A.* 43, 49174. — Back-reflection methods for the orientation of metal monocrystals were described by Ekstein and Fahrenberg (*Z. Krist.* 89, 525-8(1934)) and Greninger (*ibid.* 91, 424-32(1935)). The back-reflection conditions for structural planes with  $Zd^2$  above 100 are discussed and tabulated for crystals of Cu, Fe, Ni, Al, and their alloys, and the wave lengths most suitable in white x-radiation indicated; the transmittances through Lindemann windows are partly not favorable enough. The strong fluorescence of Cu and Zn in  $W/L$  radiation must be considered; for Fe crystals the Ag  $\gamma$  radiation is particularly suitable if the voltage is held below 25 kv. and the short waves are filtered away by Al foil (10 to 20  $\mu$  thick). The app. used was a common Laue camera type, with a goniometer head for precision adjustment of the crystal. The principle of the diagrams produced by back reflection is demonstrated for the most general case in the gnomon-stereographic projection, and its transformation to oriented positions of the crystallographic axes. For the detn. of the indexes of the spots the Greninger hyperbola diagrams are useful in isometric metal crystals. For the cubic-centered and face-centered lattices 6 "standard" stereograms are given for the directions  $[001][111][101]$  (Wulff protractor with 200 mm. diam.). The orientation of a polished Fe crystal is given as an example for the practical use of the standard diagram, and the relations in the stereographic projection demonstrated. For crystals of lower symmetry the oscillation method is more convenient than the standard projection methods. W. Eitel



MA BASHARYATSKIY, Y.S.H.

Laboratory Apparatus  
12

\*A Bent-Crystal X-Ray Monochromator. Yu. A. Basharyat-  
sky and E. V. Kukitsova (*Zhur. Lab.*, 1950, 18, (8), 855-  
961).—[In Russian]. The monochromator is intended prin-  
cipally for single-crystal work, for which flat monochromators  
(which give a beam) have too little intensity. A small aperture  
(1½-2") is used, and the geometrical arrangement allows  
the whole focal spot to be "viewed". Focusing is necessarily  
imperfect, but this is immaterial for many appn. where the  
main requirement is to remove background scattering. The  
image of the direct beam is either square or in the form of a  
narrow line. Quartz or topaz was used; the a doublet was not  
resolved. Formulae and a graph for calculating geometrical  
quantities involved are given. The adaptation of ordinary  
single-crystal cameras for use with this monochromator is  
described. The main innovation is the use of a wire cross as a  
"sight-line" (as on a gun); together with the single collimator  
pinhole, this defines the mean direction of the beam. (Ab-  
stracted from Fulmer Research Institute Translation No. 33.)  
—R. W. C.

SAGAKI, H. K. Y., Y. H.  
MA

3

**\*Structural Changes in the Ageing of an Al-Cu-Mg Alloy.**  
Yu. A. Bagaryatsky, *Zhur. Tekhn. Fiziki*, 1970, 20, (4), 424-427; *Polmer Research Inst. Translation No. 11*. (In Rus.-en). The ternary alloy Al-Cu-Mg with small amounts of Cu and Mg is the basis of many useful alloys of the Duralumin type (D10, 24S, etc.). Some X-ray diagrams of the ternary Al-Cu-Mg alloy previously studied (see preceding abstract) show that: (1) after prolonged ageing at 218° C. and after ageing at 300° and 450° C., precipitates of a new phase corresponding in lattice to that of Al<sub>2</sub>CuMg<sub>3</sub> (S phase) appear; (2) a tight crystallographic relationship exists between the lattices of the Al solid soln. and the S phase; (3) altogether, 12 crystallographically-identical orientations of the S phase are realized; (4) after ageing at 218° C. for 20-40 min., two-dimensional diffraction effects are observed by X-ray photography, with simultaneous appearance of three-dimensional diffraction from S phase precipitates; (5) max. of the two-dimensional diffraction are stretched along directions of the type [012] of the reciprocal lattice of the solid soln.; (6) X-ray photographs of the naturally aged alloy, as well as those of the alloy aged for 10,000 hr. at 100° C., and for 60 hr. at 150° C., show patterns of limited one-dimensional diffraction from formations with the correct periodicity, in directions of the type [001] of the crystal lattice of the solid soln.; (7) after ageing for 20-30 min. at 218° C., intermediate diffraction patterns are observed, viz. fairly clear spots from three-dimensional diffraction appear against a background of diffuse one-dimensional diffraction. An interpretation of these results is given. 7 ref. J. S. G. T.

BAHARYATSKIY, YU. B.  
CA

9

Probable mechanism of martensite decomposition. Yu. A. Baharyatskiy. *Doklady Akad. Nauk S.S.S.R.* 73, 1161-4 (1950). A theoretical study is made of the orientation relation of the carbide phase and martensite in the early stages of tempering. It is shown that a close relation exists between the at. distributions on the (100) plane of cementite and the (101) plane of martensite, when the [100] direction in the cementite coincides with the [121] direction in the martensite. The relation agrees with that found by experiment. The corresponding mechanism of the martensite to cementite transformation at low tempering temps. is: (1) "twinning" of martensite on (121) planes by blocks of thickness  $d \approx 2$ ; (2) shift of the C atoms to the twinning planes; (3) buckling of certain at. planes. This mechanism requires movement of Fe atoms of less than one at. spacing. A similar mechanism explains the pptn. of the second phase in aluminum. Two-dimensional x-ray diffraction effects in a [112] direction and one-dimensional effects on (110) planes of the reciprocal lattice of martensite should be observed during tempering at low temps. A. G. Guy

1957

SAGARYANSKIY, Yu. A.

258/12/8

669,715-159,8 1620,179,152

*Handwritten:* No. 258

Application of X-ray Crystallography  
Low Temperatures for Investigating  
the Structure of Al-Cu Alloys

Yu. A. Bagaryanskiy,  
E. V. Kolentsov

U.S.S.R.

crystals with monochromatic radiation at low temperatures,  
X-ray pictures of single crystals of Al-Cu and Al-Cu-Mg

alloys are presented. The work was carried out with monochromatic  
medium radiation of a synchrotron (150-200 eV, K. Pribl. No.  
107/1814).  
(Dokl. Akad. Nauk SSSR, 1977, 237, 1077, 1078.)

*Handwritten:* 2/8

*Handwritten:* SH

БЕШЕРЯТИК, Ю. А.

Journal of the Institute of Metals  
Vol. 21 Part 7  
Mar. 1954  
Properties of Alloys

~~\*On the Question of the Mechanism of the Decomposition of Supersaturated Solid Solutions in [Aluminium] Alloys (and Steel). Yu. A. Bagaryatsky (Zhur. Tekhn. Fiziki, 1961, 21, (12), 1497-1603).—[In Russian].~~ The ageing of Al alloys at intermediate temp. (150°-200° C.) results in the formation of a metastable state where the lattice of the precipitating phase and that of the solid soln. are "continuous" and the strains set up result in the hardening of the alloy. In Al-Zn, Al-Ag, and Al-Cu-Mg alloys the metastable precipitating phase is essentially the same as the stable precipitate, but in Al-Cu alloys the phases are different; the lattice relationships are given for the Al-Cu-Mg alloys and show linking along the (012) planes of the solid soln. The "first" decompn. of martensite (100°-150° C.) is thought to involve the formation of metastable Fe<sub>3</sub>C and a theoretical relationship is presented which allows linking of the strained Fe<sub>3</sub>C lattice along the (121) martensite planes. The relationship is the same as that observed experimentally for martensite decomposed at 300°-400° C. and thus supports the metastable linked-pptn. theory. In Al alloys concentration of solute atoms occurs before pptn., and it is considered important to establish whether this occurs in steels and other alloys; approaches to the problem are outlined. 36 ref. (Abstracted from Fulmer Research Institute Translation No. 45).—D. M. P.

МА БИЗАРЬАТСНІУ, Ю.А.

Laboratory apparatus  
12

**New Developments in the Technique of Focusing X-Rays.**  
Yu. A. Bagaryatsky (*Uspehi Fiz. Nauk*, 1951, **44**, (2), 292-295).—[In Russian]. A review of some new methods in the monochromatizing of X-rays. (The data on Pines' method are incorporated in the following abstract.) Attention is called to the advantage of using a (single bent) monochromator with the reflecting planes at an angle to the surface. This confers the following advantages: (i) crystal-film distance is large, allowing a large specimen-film distance (transmission method) and therefore high resolu.; (ii) films can be placed  $\perp$  the beam, again assisting resolu.; (iii) source-crystal distance small, giving good intensity. This method is especially recommended for studies of low-angle scattering. (Abstracted from Fulmer Research Institute Translation No. 34.)  
—R. W. C.

1ST AND 2ND ORDERS      PROCESSES AND PROPERTIES INDEX      3RD AND 4TH ORDERS

BAGRYATSKIY, Y. A.

SA A 548

548.732

6570. Calculation of the intensity of diffuse scattering of X-rays for ageing alloys. Yu. A. Bagryatkiy, Dokl. Akad. Nauk, SSSR, 77 (No. 1) 45-8 (1951) In Russian.

The problem is considered in 1 dimension. A foreign atom occurs (perhaps also displaced) at irregular intervals in a regular chain. The scattered intensity is made up of 3 terms, due to the regular array of atoms, due to the errors only and the cross term. Of these only the second has a value at points other than reciprocal lattice points. Following Mering (Abstr. 6159 (1950)) the diffuse scattering is calculated for a Gaussian distribution of the distances between errors. From published data the diffuse scattering in Al-Cu alloys is drawn out for 3 different degrees of segregation.

A. L. McKay

A 548.732 METALLURGICAL LITERATURE CLASSIFICATION



САГАРВА + СКРИВ, А

USSR .

The nature of phases, formed on surfaces of steel by diffu- CH  
 sion of tungsten. G. N. Dubinin and Yu. A. Bagarvatskiy. Zhur. Tekh. Fiz. 22, 1741-50, 1952. Gaseous nitro-  
 sion of W from the chloride on Fe (0.03% C) for 6 hrs. at  
 1000° gave a bright outer layer of Fe<sub>2</sub>W<sub>6</sub>, an easily etched  
 heterogeneous middle zone of α phase + Fe<sub>2</sub>W<sub>6</sub> and an in-  
 terior zone of large polyhedral crystals of α solid soln.  
 Steel (0.07% C) treated for 6 hrs. at 1100° showed an  
 etched outer layer of α plus traces of Fe<sub>2</sub>W<sub>6</sub> and Fe<sub>2</sub>W<sub>6</sub>C.  
 Steel (1.03% C) treated for 6 hrs. at 1300° was strongly de-  
 formed with a thick outer layer of α + Fe<sub>2</sub>W<sub>6</sub> with in-  
 terstitial wires of Fe<sub>2</sub>W<sub>6</sub>C. V. N. Belnarski.

of



BAGARYATSKIY, YU.A.

JSSR.

Mechanism of natural aging of aluminum alloys. Yu. A. Bagaryatskii. *Doklady Akad. Nauk S.S.S.R.* 87, 559-62

62

(1952).--The hypothesis that the 1st stages of natural aging are assocd. with the pptn. of a phase intermediate between the solid soln. and the 2nd phase (Guinier, *Mécanisme de Corrosion* 18, 209-17(1943)) and the theory that the 2nd phase is the one which ppts. originally (Geisler and Keller, *C.A.* 41, 78f) were experimentally checked and found lacking. Röntgenograms taken with a monochromatic light on monocrystals of a 3% Cu-1.13% Mg Al alloy aged for 30 min. at 218° showed that spots corresponding to the 2nd phase (Al-CuMg) did not correspond in their position to spots of the 2nd phase produced by natural aging. No particles of the 2nd phase, even in the shape of unidimensional nuclei, are produced by natural aging which lead to the formation of the 2nd phase on artificial aging. Atoms of Cu and Mg as well as of Cu and Al tending to approach each other within the space lattice of a supersatd. soln. cannot form the most thermodynamically advantageous configuration on account of the surrounding atoms of the solid soln. and can produce

1/2

(OVER)

*Yu. A. Bagaryatskii*

only partial displacements. These displacements occur only in (001) planes destroying the correct periodicity of atoms only in these planes without causing any changes in their position so that the phenomena of unidimensional diffraction can be observed. A certain disturbance in the packing of atoms is produced by these displacements leading to stresses in the lattice and changes in mech. properties of the alloy. These areas cannot be considered as those of the 2nd phase, they corresponded to the precipitate stage assoc. with the formation of a new type of bond between the atoms in the space lattice. Passing from the crystal structure of naturally aged to that of artificially aged alloy takes place through a new rearrangement of Cu and Al atoms along the (100) and (010) planes, the mechanism of transformation of this  $\delta'$  phase resembling the formation of twin planes in crystal lattice. Spots formed by the  $\delta'$  phase are not sharp, as previously claimed, but are elongated even at the earliest stages of its formation.

J. D. Mat

BAGARYATSKIY, Yu.A.; BARDIN, I.P., akademik.

Calculation of X-ray intensity dispersion at various degrees of diffraction orders in the distribution of defects in crystals. Dokl. AN SSSR 92 no.6: 1157-1160 0 '53. (MLBA 6:10)

1. Akademiya nauk SSSR (for Bardin).  
(Crystallography) (X-rays--Diffraction)

BAGARYATSKIY, Yu. A.

USSR/Physics - X-Ray Background

1 Nov 53

"Computation of Intensity of X-Ray Background at  
Various Correlation Degree of Solid Solutions,"  
Yu. A. Bagaryatskiy

DAN SSSR, Vol 93, No 1, pp 35-38

Attempts to solve problems of scattering of x-rays  
in solid soln. Obtains the same results found by  
I. M. Lifshits (ZhETF 9, 4(1939)) and Yu. N.  
Obraztsov (ZhETF 8, 5 (1938)) for the one dimensional  
case with chain atoms and in absence of distant order.  
Presented by Acad I. P. Bardin 1 Sep 53.

275T93

BAGARYATSKIY, YU. A.

USSR/Physical Chemistry - Crystals, B-5

Abst Journal: Referat Zhur - Khimiya, No 19, 1956, 60845

Author: Bagaryatskiy, Yu. A.

Institution: None

Title: Roentgenographic Investigation of Aging of Aluminum Alloys. III. Use of Roentgenogoniometric Methods for the Determination of Mutual Orientation of Phases. IV. Procedure of Computation of Diffused Scattering Photographs

Original

Periodical: Fiz. metallov i metallovedeniye, 1955, 1, No 2, 316-338

Abstract: Description of method and results of determining the orientation of equilibrium phase  $Al_2CuMg$  (S-phase) in aging alloy Al-Cu-Mg (duraluminum) and ascertaining the nature and characteristics of strengthening phase formed on artificial aging, is made of alloy monocrystals and roentgenographic pictures using Laue cameras, rotary and "KFOR" with monochromator. Roentgenogoniometric pictures in KFOR which do not distort the appearance of

Card 1/4

USSR/Physical Chemistry - Crystals, B-5

Abst Journal: Referat Zhur - Khimiya, No 19, 1956, 60845

Abstract: the planes of inverse lattice permit uniquely to determine orientation of S-phase in relation to the solid mother liquor ( $\alpha$ ):  $[\overline{100}]_S \parallel [\overline{100}]_\alpha$ ,  $[010]_S \parallel [012]_\alpha$ ,  $[001]_S \parallel [021]_\alpha$ ; there are 12 such crystallographically identical orientations of S-phase particles in the crystal. This is pointed out a correspondence in structure of  $\alpha$ - and S-phases which leads to this law of mutual orientation. Analogous pictures of the alloy following aging at 218° and analysis of the results obtained permit to reach the conclusion that in artificial aging the strengthening phase is the same S-phase but in combined state conjugated with the solid solution which causes certain peculiarities in particular a not exact fulfillment of the above stated orientation law. Considered are the possibilities of determining the mutual orientation of 2 phases by the proposed method even in that instance when the crystalline structure of one phase is unknown. IV. By means of vector analysis a computation formula is derived for the transition from coordinates in a plane picture of diffuse scattering obtained with monochromatic radiation to the coordinates in the space of inverse lattice for the point responsible for scattering

Card 2/4

USSR/Physical Chemistry - Crystals, B-5

Abst Journal: Referat Zhur - Khimiya, No 19, 1956, 60845

Abstract: in the given direction  $i$  in the case of cubic crystals:  
 $H_a(x_1 \times x_2 \times x_3) = a\lambda^{-1} \{ xQ^{-1} \dots yQ^{-1} \sqrt{S_0} \} + (DQ^{-1} - 1)S_0$ . Where  $H_a$   
 is vector of inverse lattice having coordinates  $x_1 \times x_2 \times x_3$ , measured  
 at the scale  $a^* = 1/a$  ( $a$  -- period of crystal lattice),  $x$  and  $y$   
 coordinates in picture measured in the direction of unit vector  $i$   
 of the crystal and perpendicular thereto (clockwise on looking at  
 the picture in the direction of primary beam  $S_0$ ),  $S_0$  -- unit  
 vector in the crystal of direction  $S_0$ ,  $D$  -- distance from speci-  
 men to picture (in same units as  $x$ ,  $y$ ),  $Q = \sqrt{x^2 + y^2 + D^2}$ . There  
 are given developed particular formulas for 2 instances: when  
 vector  $i$  is parallel to direction  $[100]$  or  $[110]$  in the crystal  
 and position of vector  $S_0$  is arbitrary. Derived are also formulas  
 for the inverse transition from coordinates of scattering point in  
 space of inverse lattice to the coordinates in the picture:  
 $x/D = (i) / (SS_0)$ ,  $y/D = (iS_0) / (SS_0)$ , where  $(iS)$  and  $(iS_0)$  are  
 scalar products and  $(iSS_0)$  the triple mixed product of 2 or 3  
 unit vectors in the crystal and  $S = S_0 + \lambda a^* H_a$ . In the supple-  
 ment is provided proof of multivalued nature (with accuracy up  
 to factor -1) of the values of coordinates obtained on computations

Card 3/4

USSR/Physical Chemistry - Crystals, B-5

Abst Journal: Referat Zhur - Khimiya, No 19, 1956, 60845

Abstract: by means of inverse lattice and the usual computation of pictures  
by the Laue method. Communications I and II, see Zh. tekhn.  
fiziki, 1948, 18, 827; 1951, 21, 658.

Card 4/4

BAGARYATSKIY, Yu.A.

X-ray investigation of the aging of aluminum alloys. Part 4.  
Methods of diffusion-scattering reentgenograms. Fiz.met.i  
metalloved. 1 no.2:330-338 '55. (MLRA 9:4)

1. Tsentral'nyy nauchno-issledovatel'skiy institut chernoy metalur-  
gii. (Aluminum alloys--Metallography)

BAGARYATSKIY Yu. A.

The  $\alpha$ -phase crystal structure and its nature in titanium-chromium alloys. Yu. A. Bagaryatskiy, G. I. Nosova, and V. V. Zhuravov. Doklady Akad. Nauk S.S.S.R. 105, 1925-8 (1955). The intermediate nonstoichiometric phase observed during the x-ray study of Ti-Cr alloys with 4-8% Cr after rapid quenching from 93 to 1020° and low-temp. annealing at 350-570° was called the  $\alpha$ -phase by its discoverers (Frost, et al., Can. J. 48, 6361F). The crystal structure was studied with angle crystal diffraction. The distribution of the

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BAGARYATSKIY, Yu. A.

Category : USSR/Solid State Physics - Phase Transformation in Solid Bodies E-5

Abs Jour : Ref Zhur - Fizika, No 3, 1957, No 6649

Author : Bagaryatskiy, Yu. A., Tyapkin, Yu. D.  
Inst : Institute of Metalworking and Physics of Metals. Central Scientific Research Institute for Ferrous Metallurgy.  
Title : Features of Structure of Ni-Al Alloys During the Process of Decomposition of a Supersaturated Solid Solution of Aluminum in Nickel.

Orig Pub : Dokl. AN SSSR, 1956, 108, No 3, 451-454

Abstract : An investigation was made of single crystals of a Ni-Al alloy directly after hardening at 1250 -- 1350° and during various tempering stages. The method of study involved obtaining X-ray patterns of the oscillations of the single crystals at large angles of under various types of irradiation (iron, nickel, copper, molybdenum). X-ray patterns of hardened alloys with 14.5 -- 22 atomic percent of aluminum disclosed washed-out superstructural reflections, which are forbidden for the disordered cubic face-centered lattice of the  $\gamma$ -solid

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Category : USSR/Solid State Physics - Phase Transformation in  
Solid Bodies

E-5

Abs Jour : Ref Zhur - Fizika, No 3, 1957, No 6649

solution, i.e., these alloys contain even in the hardened state submicroscopic regions that are enriched by aluminum atoms and have the remote placement sequence that is characteristic for  $Ni_{17}Al$ . The greater the aluminum content of the alloy, the greater the size of these regions (for an alloy with 17 atomic percent of aluminum the size is 200 -- 400 Å). Tempering causes growth of these regions, and at a definite stage of the hardening there is formed a structure that represents a periodic alternation in the aluminum-poor lamellar regions, in the 100 directions. The period of the modulation in the alloy with 17 atomic percent of aluminum amounts to 300 -- 400 Å after tempering at 550 -- 700° for two hours. The formation of a periodic structure does not disturb the single-crystal nature of the specimen. Prolonged tempering increases the regions with a structure of the  $\Theta'$  phase, but even soaking at 700 -- 1000° for tens and hundreds of hours does not bring the single crystal to an equilibrium state: the "particles" of the  $\Theta'$  phase remain

Card : 2/3

BAGARATSKIY, YU. A. and TYAPKIN, YU. D.

Central Research Institute of Ferrous Metallurgy, Moscow-  
"The Mechanism of the Structure Transformations in the Nickel Base Age-Hardening  
Alloys" (Section 13-4)-Paper submitted at the General Assembly and International  
Congress of Crystallography; 10-19 Jul 57, Montreal, Canada.

C-3,800,189

NYGATSKIY, YU. A.

AUTHOR: Bagaryatskiy, Yu.A.

70-2-14/24

TITLE: On the crystal structure of the metastable phase formed on the annealing of alloys of Cu and Sn containing 24-27% Sn. (O kristallicheskoj strukture metastabil'noy fazy, obrazuyushcheylya pri otpuske splavov Cu - Sn s 24 - 27% Sn)

PERIODICAL: "Kristallografiya" (Crystallography), 1957, Vol.2, No.2, pp. 283-286 (U.S.S.R.)

ABSTRACT: Isaychev and Kudryumov (Phys. Zeit.d. Dowjetunion, 5, 1, 6, 1932) established that on low temperature annealing of quenched Cu-Sn alloys in the  $\beta$ -region the decay process follows the scheme  $\beta \rightarrow \beta + \gamma' \rightarrow \alpha + \gamma$ . They concluded that the  $\gamma'$  - phase was either a cubic phase like the  $\gamma$  or was hexagonal with  $a = 7.28$  and  $c = 2.58$  KX.

The author has calculated X-ray spacings and intensities for a Cu-Sn phase of the  $\zeta$ -AgZn structure but without ordering of the atoms. Co-ordinates rounded off to be  $1/3$  or  $2/3$  (x and y) and  $1/4$  or  $3/4$  were used. The correspondence with the earlier data is good, certain discrepancies being explicable and it is considered that the  $\gamma'$  -phase of Cu-Sn should be designated as  $\zeta$ . The  $\beta \rightarrow \zeta$  transition recalls the transition of  $\beta \rightarrow \omega$  in Ti alloys. The data used by the author

Card 1/2

On the crystal structure of the metastable phase <sup>70-2-14/24</sup> formed on  
the annealing of alloys of Cu and Sn containing 24-27% Sn.  
(Cont.)

Card 2/2  
were from one rotation photograph from a single crystal and  
are far more easily obtained than from pole figures laboriously  
constructed by the earlier investigators.  
There are 2 tables and 10 references, 6 of which are Slavic..

ASSOCIATION: Institute of Metal Physics and Metallurgy.  
(TsNIICHM)

SUBMITTED: October 13, 1957.

AVAILABLE: Library of Congress

AUTHOR: Bagaryatskiy, Yu.A. and Tyapkin, Yu.D. 70-3-16/20

TITLE: The mechanism of the structure transformations in the age-hardening alloys on the nickel base. (Mekhanizm strukturykh prevrashcheniy v stareyushchikh splavakh na osnove nikelya)

PERIODICAL: "Kristallografiya" (Crystallography), 1957, Vol.2, No.3, pp. 419 - 423 (U.S.S.R.)

ABSTRACT: Binary, ternary and quaternary nickel-base alloys were investigated (see Table 1, p. 419). In all the hardenable alloys, except T - 1, T - 2, T - 3 and XT, the equilibrium precipitate ( $\gamma'$ ) possesses a close-packed ordered f.c.c. lattice with parameters little greater than those for nickel-base solid solutions. The alloys T-1, T - 2, T - 3 and XT have equilibrium precipitate ( $\eta$ ) with composition  $Ni_3Ti$  and a hexagonal close packed four-layer lattice. Alterations of lattice parameter of solid solutions and precipitates, presence or absence of superlattice reflexions and character of X-ray reflexions on the oscillating diagrams obtained by soft (Cu K $\alpha$ , Fe K $\alpha$ ) and hard (Mo K $\alpha$ ) radiations were studied. Non-hardenable alloys (solid solutions) A - 0 and T - 0 and some of hardenable alloys were also studied by X-ray diffuse scattering. Single crystals of alloys were cut from large

Card 1/4

70-3-16/20

The mechanism of the structure transformations in the age-hardening alloys on the nickel base. (Cont.)

ingots, which were first homogenized at 1 200 C for about 100 hours.

On the oscillating diagrams of all the hardenable alloys with equilibrium precipitates  $\gamma'$  and  $\eta$  (except the alloy XTA - 1, quenched from 1 250 C) superlattice reflexions were found typical of the  $Ni_3Al$  lattice. They were diffuse at large angles  $\theta$ ; by their diffuseness one can estimate the dimensions of superlattice regions in the crystals (see Table 1). The superlattice parameter for alloys A - 2 and A - 1 (3.553 and 3.547 kX.) are more than those measured by non-superlattice reflexions (3.545 and 3.541 kX.); the former, within the accuracy of measurement, is equal to the lattice parameter of  $Ni_3Al$  (3.556 kX.). Analogous results were found for alloys with equilibrium precipitate  $\eta$ : the super lattice parameter for alloy T - 2 was 3.577 kX. but the non-superlattice parameter was 3.570 kX. This all implies that sub-microscopic regions in the crystals of super-saturated solid solution which possess the superstructure are enriched by Al and Ti nearly up to a composition  $(Ni,Cr)_3(Ti,Al)$ . Dependence of Al(Ti)-rich region dimensions upon the quenching temperature (see Table 1) suggests that inhomogeneity of location of

Card 2/4

70-3-16/20

The mechanism of the structure transformations in the age-hardening alloys on the nickel base. (Cont.)

solute atoms occurs also in single-phase (at high temperature) solid solutions. In the alloy XTA-1 quenched from 1250 C we have found only local order by diffuse scattering; this was found also for equilibrium solid solutions A - O and T - O.

After short ageing at 500 - 700 C (and sometimes after non-drastic quenching) satellite reflexions appear on the oscillating diagrams obtained with soft radiation for most of the alloys. This gives evidence about the dispersion of Al(Ti)-rich and Al(Ti)-poor regions in the crystals of alloys (modulated structure). In the alloy XT the picture is slightly different, but the oscillating diagrams obtained by hard radiation (Yu.A. Bagaryatskiy and Yu.D. Tyapkin, Dokl.Ak.Nauk, USSR, (1956) 118, 451) suggest that in both cases in the crystals there are regions of both types (rich and poor in Al and Ti atoms). In addition, in the quenched alloy XT there are regions with mean (initial) lattice parameter.

In the alloys with equilibrium precipitate  $\gamma'$  progressive ageing causes growth of Ti- and Al-rich regions with superstructure. The maximum hardness is obtained when the dimensions of these regions are about 200 - 400 Å. In the crystals of alloys with equilibrium precipitate  $\eta$  (the T and XT alloys)

Card 3/4

BAGARYATSKIY, YU. A.

AUTHORS: Bagaryatskiy, Yu. A., Tyapkin, Yu. D.

29-6-16/48

TITLE: On the Mutual Relation of the Process of Diffusion and of Lattice Rebuilding During the Decomposition of the Supersaturated Solid Solutions in Alloys. (O vzaimo-otnoshenii protsessov diffusii i perestroyki reshetki pri raspade peresyshchennykh tverdykh rastvorov v splavakh)

PERIODICAL: Doklady AN SSSR, 1957, Vol. 115, Nr 6, pp. 1111-1114 (USSR)

ABSTRACT: The results of the investigation of the decomposition of the supersaturated solid solutions of titanium in nickel and nickel-chromium obtained by the authors and mentioned in the present paper according to the opinion of the authors make it possible clearly to confirm the modification of the composition due to diffusion. The nickel-titanium alloys T-2 with 11,8 % Ti and T-3 with 13 % Ti as well as the ternary alloy nickel-chromium-titanium(KhT) with 15,2 % Cr and 7,1 % Ti were investigated. The equilibrium phase of the segregations in these alloys at 700 - 900° and below is the so-called  $\eta$ -phase (ni,Ti) with four-ply close-packed hexagonal structure. At a heating temperature below the quenching (1250°) the second phase in the solid solution dissolves on nickel base ( $\gamma$ -phase). The radiographic investigations of the monocrystals

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On the Mutual Relation of the Process of Diffusion and of Lattice Rebuilding During  
the Decomposition of the Supersaturated Solid Solutions in Alloys. 20-6-16/48

succession of diffusion and rebuilding process ought to be true also for the  
eutectoid decomposition of a supersaturated solid solution. There are 4  
figures, 1 table, 18 references, 13 of which are Slavic.

ASSOCIATION: Institute for Metallography and Physics of Metals of the Central  
Scientific Research Institute for Ferrous Metallurgy (Institut  
metallovedeniya i fiziki metallov Tsentral'nogo nauchno-  
issledovatel'skogo instituta chernoy metallurgii)

PRESENTED: By Kurdyumov, S. G., Academician, March 4, 1957

SUBMITTED: March 2, 1957

AVAILABLE: Library of Congress

Card 3/3

BAGARYATSKIY, Yu.A.

Determining the unit cell of the precipitating phase using one X-ray diffraction photograph of rotating monocrystal of the initial phase with particles of the new. Kristallografia 3 no.1:10-16 '58.

(MIRA 11:5)

1. Institut metallovedeniya i fiziki metallov Tsentral'nogo nauchno-issledovatel'skogo instituta chernoy metallurgii.

(Titanium—Chromium alloys) (X-rays—Diffraction)

BAGARYATSKIY, Yu. A.; NOSOVA, G. I.

More precise coordinates of the atoms in metastable  $\beta$  -phase in  
Ti - Cr alloys. Kristallografia 3 no. 1:17-28 '58. (MIRA 11:5)

1. Institut metallovedeniya i fiziki metallov Tsentral'nogo  
nauchno-issledovatel'skogo instituta chernoy metallurgii.  
(Titanium-Chromium alloys) (Metal crystals)

BAGARYATSKIY, Yu.A.; NOSOVA, G.I.; TAGUNOVA, T.V.

Structural diagrams of titanium - Chromium, titanium - tungsten,  
titanium - chromium -tungsten alloys, prepared by the powder metallurgy  
method. Zhur. neorg.khim. no.3:777-785 '58. (MIRA 11:4)

1.Institut metallovedeniya i fiziki metallov Tsentral'nogo nauchno-  
issledovatel'skogo instituta chernoy metallurgii.  
(Titanium-chromium-tungsten alloys)

AUTHOR: Bagaryatskiy, Yu.A.

SOV/70-3-1-3/26

TITLE: The Determination of the Unit Cell of a Precipitated Phase by One Rotation Photograph of a Single Crystal of the Initial Phase Containing Particles of the New Phase (Opredeleniye elementarnoy yacheyki fazy vydeleniya po odnomu snimku vrashcheniya monokrystalia iskhodnoy fazy s chastitsami novoy)

PERIODICAL: Kristallografiya, 1958, Vol 3, Nr 1, pp 10 - 16 (USSR)

ABSTRACT: A method is described of determining the co-ordinates of the reciprocal lattice points of the cell of a precipitated phase- in this case the omega-phase in the Ti-Cr system, which has many orientations relative to the initial single crystal of the cubic system, from only one X-ray rotation or oscillation photograph. The initial phase in this example was  $\beta$ -Ti-Cr. A rotation photograph about  $[100]_{\beta}$  was taken and the non- $\beta$ -phase spots could be indexed on the basis of omega-phase crystals in 4 orientations such that c (omega) was parallel to  $[111]_{\beta}$  and a (omega) was parallel to

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SOV/70-3-1-3/26

The Determination of the Unit Cell of a Precipitated Phase by One Rotation Photograph of a Single Crystal of the Initial Phase Containing Particles of the New Phase

$[110]_{\beta}$  . The axial lengths were  $a(\omega) = \sqrt{2} a_{\beta}$  and  $2c(\omega) = \sqrt{3} a_{\beta}$  . The spots were identified from their occurrence on lines of constant  $\theta$  . There are 5 figures, 1 table and 8 references, 7 of which are Soviet and 1 English.

ASSOCIATION: Institut metallovedeniya i fiziki metallov  
TsNIICM (Central Scientific Research Institute  
for Ferrous Metals)

SUBMITTED: January 2, 1957

Card 2/2

SOV/70-3-1-4/26

**AUTHORS:** Bagaryatskiy, Yu. A. and Nosova, G. I.

**TITLE:** A More Accurate Determination of Atomic Co-ordinates of the Metastable  $\omega$ -phase in Ti-Cr Alloys (Utochneniye koordinat atomov v metastabil'noy  $\omega$ -faze v splavakh Ti-Cr)

**PERIODICAL:** Kristallografiya, 1958, Vol 3, Nr 1, pp 17-28 (USSR)

**ABSTRACT:** A precession X-ray camera, which gives directly the reciprocal lattice, was used to confirm the trigonal symmetry of the  $\omega$ -phase which was established by the present authors (Ref 1). More accurate values for the atomic co-ordinates in the hexagonal unit cell are now given. It was established earlier (Refs 1, 4) that the lattice of the  $\omega$ -phase is hexagonal with three atoms in the unit cell and the following values were found for an annealed titanium-5% chromium alloy  $a_{\omega} = 4.60 \text{ kX}$ ,  $c_{\omega} = 2.82 \text{ kX}$ . Similar values were found by Silcock et al (Ref 2). The position of the atoms in the unit cell corresponded to  $000, \pm (1/3, 2/3, u)$  where  $u = 0.48 \pm 0.01$ . In Ref 2 the value of  $u$  was found to be  $1/2$ . However, this small difference in the values of  $u$  leads to a difference in the space groups and symmetry. In the first case, the

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SOV/70-3-1-4/26

A More Accurate Determination of Atomic Co-ordinates of the  
Metastable  $\omega$ -phase in Ti-Cr

crystal belongs to trigonal subsyngony (space group  $D_{3d}^3 - P\bar{3}m1$ ). If, however,  $u = 1/2$  the space group is  $D_{6h}^1 - P6/mmm$ . In order to resolve this discrepancy, the symmetry of the  $\omega$ -phase and the atomic co-ordinates were re-determined using the X-ray camera described by Bagaryatskiy and Umanskiy (Ref 5). Hard molybdenum radiation was employed. The structure of the metastable  $\omega$ -phase in an annealed titanium-5% chromium alloy which was found in Ref 1 has been confirmed again. The space group is  $D_{3d}^3 - P\bar{3}m1$ ,  $a_{hex} = 4.60_{7\pm 5}$  kX,  $c_{hex} = 2.82_{1\pm 3}$  kX. The position of the atoms is now found to be as follows  $3(Ti,Cr) - 000, \pm(1/3 \ 2/3 \ u)$  where  $u = 0.480 \pm 0.003$ . Almost complete transformation of the  $\beta$ -crystal into the  $\omega$ -phase on annealing was established in accordance with the following law:

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$$\underline{a}_{\omega} \parallel [1\bar{1}0]_{\beta}, \quad \underline{c}_{\omega} \parallel [111]_{\beta}$$

SOV/70-3-1-4/26  
A More Accurate Determination of Atomic Co-ordinates of the  
Metastable  $\omega$ -phase in Ti-Cr

(the amount of the residual  $\beta$ -phase is not more than  
5-10%).

There are 6 figures, 4 tables and 11 references, 7 of  
which are Soviet and 4 English.

ASSOCIATION: Institut metallovedeniya i fiziki metallov TsNIChM  
(Institute of Metallography and Physics of Metals  
TsNIChM)

SUBMITTED: January 2, 1957

Card 3/3

AUTHOR:

Bagaryatskiy, Yu. A.

78-3-31/47

TITLE:

Investigations of the Chromium Angle in the Diagram of the System Chromium-Nickel-Aluminum and the Quasibinary Section Cr-NiAl (Issledovaniye khromovogo ugla v diagramme khrom-nikel'-alyuminiy i kvazibinarnogo razreza Cr-NiAl)

PERIODICAL:

Zhurnal Neorganicheskoy Khimii, 1958, Vol. 3, Nr 3, pp. 722-725 (USSR)

ABSTRACT:

The present paper deals with the investigation of the chromium angle in the diagram chromium-nickel-aluminum and of the quasibinary section Cr-NiAl. The results show that the solubility of nickel-aluminum in chromium highly decreases with a decrease in temperature. While the eutectic composition given in publications at 38% chromium, a composition of 42-43% chromium was determined in the present paper. The alloys rich in nickel have two phases at 1250° C,  $\alpha + \beta$ , three phases at 950° C. On the basis of these results a complete phase diagram for the ternary system Cr-Ni-NiAl was constructed. The solubility of chromium in NiAl is less than that found by A. Taylor and R.W. Floyd. The alloys were investigated by microstructural and X-ray analysis. In the alloys

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Investigations of the Chromium Angle in the Diagram of the System Chromium-Nickel-Aluminum and the Quasibinary Section Cr-NiAl 78-3 3 31/47

molybdenum was added to the section Cr-NiAl and it was found that molybdenum dissolves well in the  $\alpha$ -phase, and that it is practically insoluble in the  $\beta$ -phase. From the radiographs it is to be seen that the lines of the  $\alpha$ - and  $\beta$ -phase in samples with little molybdenum coincide, and that in the case of a larger addition of molybdenum the lines of the  $\alpha$ -phase vanish. There are 6 figures and 8 references, 6 of which are Soviet.

ASSOCIATION: Institut metallovedeniya i fiziki metallov Tsentralnogo nauchno-issledovatel'skogo instituta chernoy metallurgii - Moskva (Institute for Metallography and Physics of Metals of the Central Scientific and Research Institute for Ferrous Metallurgy, Moscow)

Card 2/2

78-3-3-40/47

AUTHORS: Bagaryatskiy, Yu. A., Nosova, G. I., Tagunova, T. V.

TITLE: Investigations of the Phase Diagrams of the Alloys Titanium-Chromium, Titanium-Tungsten and Titanium-Chromium-Tungsten, Produced by the Method of Powder-Metallurgy (Izucheniye diagramm sostoyaniya splavov titan-khrom, titan-vol'fram i titan-khrom-vol'fram, izgotovlennykh metodom poroshkovoy metallurgii)

PERIODICAL: Zhurnal Neorganicheskoy Khimii, 1958, Vol.3, Nr 3, pp.777-784 (USSR)

ABSTRACT: The metallic-ceramic alloys titanium-chromium, titanium-tungsten and titanium-chromium-tungsten were produced by the calcium-hydride method. After melting the alloys were tempered at 950 - 1000°C. The produced alloys were investigated by radiographic and microstructural methods. In the system titanium-chromium it was found that at 670°C and 15,5 % chromium an eutectic transformation  $\beta \rightarrow \alpha + \text{TiCr}_2$  occurs. In the diagram of titanium-tungsten with more than 20 % tungsten the phases  $\alpha + \beta + \delta$  were not observed. At a temperature of 725°C an eutectic decomposition of the

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78-3.3-40/47

Investigations of the Phase Diagrams of the Alloys Titanium-Chromium,  
Titanium-Tungsten and Titanium-Chromium-Tungsten, Produced by the Method  
of Powder-Metallurgy

$\beta$ -phase occurs. The eutectoid concentration lies at 28 % tungsten. The products which occur in the eutectoid decomposition are solid solutions of tungsten in  $\alpha$ -titanium ( $\alpha$ -phase) and titanium in tungsten ( $\beta$ -phase). In the ternary diagram titanium-chromium-tungsten stable solid solutions occur at 1000°C in all investigated domains. In alloys with small quantities of chromium and tungsten a transformation of  $\beta$  to  $\alpha'$  occurs after hardening at 1000°C. On the basis of the investigations it was found that the phase diagram of the system titanium-chromium-tungsten belongs to domains rich in titanium of the type of the eutectic phase diagram. The triple eutectoid  $\alpha + \sigma + \text{TiCr}_2$  forms in the domain of a comparatively low temperature (500°C). There are 12 figures, 1 table, and 6 references, 3 of which are Soviet.

ASSOCIATION: Institut metallovedeniya i fiziki metallov Tsentral'nogo nauchno-issledovatel'skogo instituta chernoy metallurgii (Institute for Metallography and Physics of Metals. Central Scientific Research Institute for Ferrous Metallurgy)

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78-3.3-40/47  
Investigations of the Phase Diagrams of the Alloys Titanium-Chromium,  
Titanium-Tungsten and Titanium-Chromium-Tungsten, Produced by the Method  
of Powder-Metallurgy

SUBMITTED: June 25, 1957

Card 3/3

AUTHORS: Bagaryatskiy, Yu. A., Tyapkin, Yu. D. 78-3-4-17/38

TITLE: Radiographic Determination of the Limit of Solubility of Coarse-Grained Samples by the Vibration Method (Rentgenograficheskoye opredeleniye granits rastvorimosti na krupnozernistykh obraztsakh metodom kolebaniy)

PERIODICAL: Zhurnal Neorganicheskoy Khimii, 1958, Vol. 3, Nr 4, pp. 934-935 (USSR)

ABSTRACT: The limits of solubility of coarse-grained samples were determined according to the vibration method published in "Zavodskaya laboratoriya" n.6, 1958. For the determination of crystallographic orientation of the grains in the sections Laue photographs (Laue) were used. The symmetric Laue photograph at the same time serves for the determination of the effective distance from the sample to the film. By these methods the limits of solubility of titanium in nickel at 1100° and 800°C were determined. The following values were found: 11,8±0,3 at%Ti (9,8±0,3 % by weight Ti) and 9,6±0,3 at%Ti (8,1±0,3 % by weight Ti). Also the parameters of the  $\eta$ -phase Ni<sub>3</sub>Ti separated at 800°C

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Radiographic Determination of the Limit of Solubility of  
Coarse-Grained Samples by the Vibration Method

78-3-4-17/38

were determined. Ni<sub>3</sub>Ti has an hexagonal lattice with  
 $a = 2,537_{\pm 5}$ ,  $c = 8,306_{\pm 8}$  and  $c/a = 3,273 = 2.1,636$ .  
The limit of solubility of aluminum in nickel at 1150° C  
was determined:  $16,5_{\pm 0,3}$  at%Al ( $8,3_{\pm 0,2}$  weight % Al).  
The limit of solubility can also be determined directly in  
the treated samples at higher temperatures.  
There are 1 figure and 3 references.

ASSOCIATION:

Institut metallovedeniya i fiziki metallov. Tsentral'nogo  
nauchno-issledovatel'skogo instituta chernoy metallurgii  
(Institute for Metallurgy and Physics of Metals of the Central  
Scientific Research Institute for Ferrous Metallurgy)

SUBMITTED:

June 25, 1957

Card 2/2

SOV/137-58-7-15649

Translation from: Referativnyy zhurnal, Metallurgiya, 1958, Nr 7, p 247 (USSR)

AUTHORS: Bagaryatiskiy, Yu. A., Tagunova, T. V., Nosova, G. I.

TITLE: Metastable Phases in Alloys of Titanium with Transition Elements (Metastabil'nyye fazy v splavakh titana s perekhodnymi elementami)

PERIODICAL: Sb. tr. In-t metalloed, i fiz. metallov Tsent. n.-i. in-ta chernoy metallurgii, 1958, Vol 5, pp 210-234

ABSTRACT: It is shown that in alloys of Ti with transition metals (Cr, Mn, Fe, Co, V, Mo, and W) the existence of several metastable phases (MP) is possible at room temperature. The (MP)  $\alpha'$  differs from the stable phase (SP)  $\alpha$  only by the supersaturation with the second element; it forms from the high temperature  $\beta$  phase by the martensite process by rapid cooling. The  $\beta$  phase can also exist in the metastable condition with the concentration of the second element higher than a certain critical one (but lower than that of the equilibrium in the Ti-V and Ti-Mo alloys). Under these conditions it acquires certain anomalous properties (for example a negative temperature coefficient for the resistance). Also, MP's

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SOV/137-58-7-15649

Metastable Phases in Alloys (cont.)

can be formed with a crystalline structure differing from the SP structure: the  $\alpha''$  phase with a rhombic lattice and the  $\omega$  phase which is probably a low-temperature modification of the  $\beta$  phase. The  $\omega$  phase may form both by the diffusion-free process and in the process of the annealing of the  $\beta$  phase. All three MP's developing from the  $\beta$  phase on tempering, the  $\alpha'$ , the  $\alpha''$ , and the  $\omega$  phase do not demand any transposition of atoms surpassing interatomic distances for their formation and are martensite phases. The  $\omega$  phase is a martensite phase of a special type, because during its formation no design in relief appears on its surface. Bibliography: 22 references.

1. Titanium alloys--Stability    2. Titanium alloys--Phase studies    L. V.

Card 2/2

137-58-6-13261

Translation from: Referativnyy zhurnal, Metallurgiya, 1958, Nr 6, p 298 (USSR)

AUTHORS: Bagaryatskiy, Yu.A., Petrova, Z.M., Utevskiy, L.M.

TITLE: Phase Diagram of the Ni-Cr-NiAl Alloy System (Diagramma sostoyaniya sistemy Ni-Cr-NiAl)

PERIODICAL: Sb. tr. In-t metalloved. i fiz. metallov Tsent. n.-i. in-ta chernoy metallurgii, 1958, Vol 5, pp 235-240

ABSTRACT: The alloys were smelted in a high-frequency furnace in an Ar atmosphere, homogenized at 1400-1430°C in an Ar atmosphere for 2-4 hr, and examined by microstructural and X-ray analyses. The eutectic temperature of the quasi-binary section Cr-NiAl was 1450°, the solubility of NiAl in Cr at 1150-1250° was 6-7 atom %, the maximum solubility of NiAl in Cr at the eutectic temperature is 27-28 atom %, the eutectic point lies about 60-62 atom % NiAl. Also investigated were a number of alloys rich in Cr, and the borders of the region of solid  $\alpha$  solution at 1250, 1150, and 950° were plotted. Refer also RzhMet, 1956, Nr 1, abstract 644.

L.V.

1. Nickel alloys--Phase studies 2. High frequency heating--Applications

Card 1/1

SOV/137-58-9-19853

Translation from: Referativnyy zhurnal, Metallurgiya, 1958, Nr 9, p 250(USSR)

AUTHORS: Bagaryatskiy, Yu.A., Tyapkin, Yu.D.

TITLE: X-ray Study of the Process of Aging of Nickel-base Alloys  
(Rentgenograficheskoye izucheniye stareniya splavov na  
nikelevoy osnove)

PERIODICAL: Sb. tr. In-t metalloved. i fiz. metallov Tsentr. n.-i. in-ta  
chernoy metallurgii, 1958, Vol 5, pp 241-265

ABSTRACT: Alloys of the following systems were investigated: Ni-Al, Ni-Ti, Ni-Cr-Al, Ni-Cr-Ti, Ni-Al-Mo, and Ni-Cr-Al-Mo. An X-ray diffraction study was carried out with the aid of X-ray photographs taken of monocrystals by the method of vibrations. It is demonstrated that the process of decomposition of a supersaturated solid solution begins prior to the tempering of a quenched alloy. The quenched state is already an initial stage in the process of transformation of a single-phase solid solution into a two-phase system. In the case of a solid solution which has become supersaturated after quenching, the distribution of atoms of Al or Ti in the lattice of the solvent is not uniform. Regions in which the formation of a superlattice of

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SOV/137-58-9-19853

X-ray Study of the Process of Aging of Nickel-base Alloys

the  $\text{Cu}_3\text{Au}$  type is possible vary in size in various alloys from 50 to 1000 angstrom, depending on the composition of the alloy, the temperature, and the intensity of quenching. The formation of areas with ordered atoms in a supersaturated solid solution takes place not only in alloys containing Al, where the equilibrium  $\gamma$  phase ( $\text{Ni}_3\text{Al}$ ) is ordered and possesses the same type of lattice as the solid solution, but also in Ti alloys in which the equilibrium phase possesses a different type of lattice. Introduction of Cr affects the kinetics of aging but does not influence the mechanism of the transformations. Two stages of aging exist in alloys containing Ti: 1) Diffusional distribution of Ti atoms (and Cr atoms in ternary alloys) and the formation, within the crystals of the solid solution undergoing aging, of sub-microregions which are either enriched with Ti or depleted therein; 2) modification of the cubic lattice (in regions the composition of which is already prepared) into a hexagonal configuration characteristic of the equilibrium precipitation phase followed by growth and segregation of particles of the new phase.

1. Nickel alloys--Aging
2. Nickel alloys--X-ray analysis
3. Single crystals--X-ray analysis

L.M.

Card 2/2

SOV/70-3-5-7/24

AUTHOR: Bagaryatskiy, Yu.A.

TITLE: X-ray Structural Investigation of the Ageing of Aluminium Alloys (Rentgenograficheskoye issledovaniye stareniya alyuminiyevykh splavov) V. The Application of Special Forms of Photographs for Examining the Peculiarities of the Structures of Alloys (V. Frimeneniye spetsial'nykh vidov s"yemki dlya vyyasneniya osobennostey struktury splavov)

PERIODICAL: Kristallografiya, 1958, Vol 3, Nr 5, pp 570-577 (USSR)

ABSTRACT: (Earlier parts Zh. Tekh. Fiz., 1948, Vol 18, p 827 and 1951, Vol 21, p 658; Fiz. Metallov i Metalloved., 1955, Vol 1, p 316 and 1955, Vol 1, p 330). The aim of X-ray diffraction technique is to present a picture of the reciprocal lattice of the crystal under investigation. In metal precipitation, diffraction effects occur between the usual diffraction spots. The method of using a single crystal oscillation camera with small ( $5-10-15^\circ$ ) angles of oscillation so that the zero layer of the reciprocal lattice perpendicular to the beam just dips into the sphere of reflection is described. An undistorted representation of a limited region of reciprocal space is obtained. This is illustrated with photographs of Al-Cu (4% Cu) after

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SOV/70-3-5-7/24

X-ray Structural Investigation of the Ageing of Aluminium Alloys.  
V. The Application of Special Forms of Photographs for Examining  
the Peculiarities of the Structures of Alloys

platelets of the  $\theta'$  phase which is just appearing are about 25 Å thick. Monochromatised Mo radiation is used and is essential for this work. An example of the effects of ageing in an Al-Cu-Mg alloy (3% Cu, 1.15% Mg) is also shown. Changes in the breadths of the main spots on ageing are visible.

The second method uses the angular divergence in the incident beam to illuminate a finite volume in reciprocal space. Here, the crystal is kept stationary and filtered Mo radiation was used. Pictures were taken from the Al-Cu alloy (above) showing extended spots and (with monochromatised radiation) from the Al-Cu-Mg alloy after various degrees of ageing. In the latter, the changes of the forms of the reflections  $hk\ell$  from the S-phase on ageing are visible. The relative orientations of the  $\alpha$ - solid solution and the S-phase can be seen.

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SOV/70-3-5-7/24

X-ray Structural Investigation of the Ageing of Aluminium Alloys.  
V. The Application of Special Forms of Photographs for Examining  
the Peculiarities of the Structures of Alloys

There are 9 figures and 14 references, 12 of which  
are Soviet, 1 English and 1 German.

ASSOCIATION: Institut metallovedeniya i fiziki metallov and  
TsNIIChermet (Institute of Metallography and  
Metal Physics) and (Central Scientific Research  
Institute for Ferrous Metals)

SUBMITTED: November 4, 1957

Card 3/3

SOV/70-3-5-8/24

AUTHOR: Bagaryatskiy, Yu.A.

TITLE: X-ray Structural Investigations of the Ageing of Aluminium Alloys (Rentgenograficheskoye issledovaniye stareniya alyuminiyevykh splavov)  
 VI. Methods of Computing the Diffuse Scattering (VI. Metody vychisleniya diffuznogo rasseyaniya)

PERIODICAL: Kristallografiya, 1958, Vol 3, Nr 5, pp 578-586 (USSR)

ABSTRACT: Formulae are derived for calculating the intensity of the diffuse scattering both in the pre-precipitation stages and during the formation of small regions of a second phase during ageing. Existing theories are criticised. The intensity of the diffuse scattering due to the disturbance of the strict periodicity of a crystal K in regions B is given by:

$$I_{\text{diffuse}}(\underline{H}) = \left| \int_{\Sigma v_B} \rho(\underline{x}) \exp^{2\pi i \underline{x} \underline{H}} dv_x \right|^2 + \left| \int_{\Sigma v_B} \rho_0(\underline{x}) \exp^{2\pi i \underline{x} \underline{H}} dv_x \right|^2 - 2 \left( \begin{array}{l} \text{Real} \\ \text{part} \\ \text{of} \end{array} \right) \left( \int_{\Sigma v_B} \rho(\underline{x}) \exp^{2\pi i \underline{x} \underline{H}} dv_x \right) \left( \int_{\Sigma v_B} \rho_0(\underline{x}) \exp^{2\pi i \underline{x} \underline{H}} dv_x \right) \quad (8)$$

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X-ray Structural Investigations of the Ageing of Aluminium Alloys  
VI. Methods of Computing the Diffuse Scattering

where  $\underline{x}$  is the position vector in real space and  $\underline{H}$  that in reciprocal space,  $\rho$  is the electron density and  $\rho_0$  the undisturbed electron density.  $\sum v_B$  is the totality of the disturbed regions. The results of calculation from this formula are compared with experimental measurements of the diffuse intensity from Al-Cu-Mg and Al-Cu alloys during ageing. Here, the disturbed regions are 20-40 Å in diameter. The interpretation of the results is not unambiguous and various authors diverge considerably in their attitude. There are 6 figures and 38 references, 16 of which are Soviet, 7 English, 8 Scandinavian, 5 French and 2 German.

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SOV/70-3-5-8/24

X-ray Structural Investigations of the Ageing of Aluminium Alloys  
VI. Methods of Computing the Diffuse Scattering

ASSOCIATIONS: Institut metallovedeniya i fiziki metallov  
(Institute of Metallography and Metal Physics)  
TzNIIChermet

SUBMITTED: November 4, 1957

Card 3/3

AUTHOR: Bagaryatskiy, Yu.A. 32-1-54/55

TITLE: The Method of Computing Debye Diagrams of Cubic Crystals With  
a Sliding Rule (Sposob rascheta debayegramm  
kubicheskikh kristallov s pomoshch'yu logarifmicheskoy lineyki).

PERIODICAL: Zavodskaya Laboratoriya, 1958, Vol. 24, Nr 1, pp. 121-123 (USSR)

ABSTRACT: In this paper it is suggested to use the calculating rule usually  
used for technical computations for computing the angles of the  
reflected intensity according to Wulff and Bragg with respect to  
cubic crystals of a known lattice constant. Likewise it is recom-  
mended to solve also tasks of a reversed type by means of the  
same calculating rule, e.g.: To determine the lattice constants of  
cubic crystals according to existing radiogram lines or to de-  
termine other required values from existing ones. For this purpose  
it is recommended to mark the most usual values of the radiations  
 $\lambda/2$  (see fig.) upon the tangent points of the calculating rule  
and then to read off the squares of the angles  $\theta$  corresponding to  
 $\sum h^2 = 1,2,3$  etc. after a calculating rule has been adjusted

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The Method of Computing Debye Diagrams of Cubic Crystals  
With a Sliding Rule

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according to the marked values of the investigated radiation. This operation corresponds to the solution of the equation by Wulff and Bragg:

$$\sin \vartheta = \frac{\lambda}{2a} \sqrt{\sum h^2}$$

which corresponds to the following formula in the logarithmic coordinates:

$$\log a - \log \frac{\lambda}{2} = \log \sqrt{\sum h^2} - \log \sin \vartheta$$

When solving reversed problems, the calculating rule must be in a position at which the full values correspond to the values of the angle of the respective system of radiation on the scale. In the case of such a position the unknown value can be determined according to the other known values. There are 2 figures.

ASSOCIATION: Central Scientific Research Institute for Ferrous Metallurgy  
(Tsentral'nyy nauchno-issledovatel'skiy institut chernoy metallurgii).

AVAILABLE: Library of Congress  
Card 2/2 1. Rulers-Slide-Computation methods

BAGARYATSKIY, Yu.A.; TYAPKIN, Yu.D.

X-ray determination of lattice periods of cubic crystals of grain samples without the use of a standard. Zav. lab. 24 no.5:554-561 '58. (MIRA 11:6)

1. Tsentral'nyy nauchno-issledovatel'skiy institut chernykh metalov. (X-ray crystallography)

18(6)

SOV/20-122-4-14/57

AUTHORS:

Bagaryatskiy, Yu. A., Nosova, G. I., Tagunova, T. V.

TITLE:

The Laws of the Formation of Metastable Phases in Titanium Alloys (Zakonomernosti obrazovaniya metastabil'nykh faz v splavakh na osnove titana)

PERIODICAL:

Doklady Akademii nauk SSSR, 1958, Vol 122, Nr 4, pp 593-596 (USSR)

ABSTRACT:

In previous papers (Refs 1, 2), the authors investigated the alloys Ti-Cr, Ti-W, Ti-Mn in which the metastable phases  $\alpha'$ ,  $\alpha''$ ,  $\omega$ , and  $\beta$  are formed by calcination of the high-temperature  $\beta$ -phase. This paper investigates a wider complex of alloy systems: The authors investigated (after hardening and tempering) alloys of titanium with transition elements of the 4<sup>th</sup>, 5<sup>th</sup>, and 6<sup>th</sup> periods of the periodical system of the elements: vanadium, niobium, tantalum, molybdenum, tungsten, and rhenium. These alloys were produced in a metal-ceramic manner on the basis of titanium. The phase composition of all the investigated alloys were found by radiography. The metastable phases  $\alpha''$  and  $\omega^*$  (which do not occur in the equilibrium diagrams of state) are formed (by harden-

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The Laws of the Formation of Metastable Phases in Titanium Alloys

ing) in all the investigated systems at defined concentrations of the second element. The minimum hardness of the alloys corresponds to the presence of an  $\alpha''$  phase in the alloys. The sharp maximum of hardness, however, corresponds to the presence of the  $\omega$ -phase. A diagram shows the laws of the dependence of the rhombic cell of the  $\alpha''$ -phase on the composition for the alloys Ti-Mo and Ti-Nb. The  $\omega$ -phase (together with the remanent  $\beta$ -phase) is sufficiently well visible (after hardening) in the radiograms of the following alloys: with 14 % V, with 24 % W, with 10 % Mo, and somewhat less distinctly - in the radiograms of the hardened alloys with 28 % Nb and 14 % Re. An other diagram gives the concentrations at which the  $\alpha''$ -phase and the  $\omega$ -phase occur in the investigated titanium alloys during hardening. In all the investigated systems, a tempering of the alloys in which the  $\beta$ -phase is conserved after hardening causes a formation of an  $\omega$ -phase in them by diffusion. The total scheme of the decomposition of the  $\beta$ -phase is shown in a figure. The tempering of the alloys of the  $\alpha''$ -phase structure was investigated in detail only for the alloys Ti-W, Ti-Mo, and Ti-Nb. This decomposition satisfies the scheme  $\alpha'' \rightarrow \alpha + \beta$ . In all the investigated cases, considerable increase of the hardness of alloys was observed

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The Laws of the Formation of Metastable Phases in <sup>SOV/20-122-A-14/51</sup> Titanium Alloys.

in the initial stage of the decomposition of the  $\alpha''$ -phase.  
There are 4 figures, 1 table, and 4 references, 3 of which  
are Soviet.

ASSOCIATION: Institut metallovedeniya i fiziki metallov Tsentral'nogo  
nauchno-issledovatel'skogo instituta chernoy metallurgii  
(Institute of Metallography and Metal Physics of the Central  
Scientific Research Institute of Ferrous Metallurgy)

PRESENTED: May 24, 1958, by G. V. Kurdymov, Academician

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16(7)

AUTHORS:

Bagaryatskiy, Yu. A., Tyapkin, Yu. D.

SOV/20-122-5-16/56

TITLE:

On the Atomic Structure of the Solid Solutions of Chromium in Nickel (Ob atomnom stroynii tverdykh rastvorov khroma v nikel'e)

PERIODICAL:

Doklady Akademii nauk SSSR, 1958, Vol 122, Nr 5, pp 806 - 809 (USSR)

ABSTRACT:

Several earlier papers dealing with this subject are discussed first. By using the method of the diffuse scattering of X-rays the authors investigated alloys of 28 and 35 gram-atomic percentage chromium. These alloys were investigated in a quenched and in a tempered state (at 450°, for 100 hours). The X-ray pictures of the diffuse scattering were taken by means of monochromatized molybdenum-K<sub>α</sub> radiation for 2 orientations of the monocrystals of the alloys. In the X-ray pictures of the 2 alloys tempered at 450° for 100 hours, additional weak maxima were observed (besides the thermal maxima which correspond to the main reflections on the cubic

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On the Atomic Structure of the Solid Solutions of Chromium in Nickel

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surface-centered lattice of the solid solution). The position of these maxima corresponds approximately to the position of the nodes of the rhombic lattice of  $Ni_2Cr$  in the case of the following relation between the orientation of  $Ni_2Cr$  and the solid solution:  $[001]_{rhombic} \parallel [001]_{cubic}$ ;  $[100]_{rhombic} \parallel [110]_{cubic}$ ,  $[010]_{rhombic} \parallel [\bar{1}0]_{cubic}$ . A table contains the results obtained by calculating the position of the maxima in the X-ray pictures. The maxima observed agree well with the superlattice reflections which correspond to the structure of  $Ni_2Cr$ , which was given by G.Baer (Ref 10), and to the ratio of alloys shown by a diagram. The broadening of the superlattice reflections permits a rough estimation of the dimensions of such domains as have a superstructure: For the two investigated alloys an order of magnitude of 50 Å was obtained (after tempering). On the X-ray pictures of the quenched samples of both alloys

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